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AGRICULTURAL MEMORANDUM 514

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Weather and Barley Yield.(1),

Number of Ears per Plant

One way to relate the yield of grain with the weather is to split up the yield into its components and look at the weather response for each.

The yield components are:

1. Weight per grain.

2. Number of grains per ear.

3. Number of ears per plant.

4. Number of plants per unit area of land.

Data

A maximum of 20 sets of trial data from the European Brewery Convention trials 1953-1969 had all the necessary information.

Tillering in Barley

Recent work by Aspinall (Australia), Cannell (UK) and Kirby (UK) indicates the following:

1. The production of the first four or so tiller buds is independent of environment and is related to internal plant factors.

2. The coleoptile node tiller, and the tillers in the axils of the third and higher true leaves were more susceptible to environment than the others.

3. Conditions which favour tillering and their survival to become ears include heavy nitrogen fertilizer application and high light intensities at the level of the growing tillers (achieved by low plant density)

4. Aspinall considers the amount of light to be especially important just after the formation of stamen initials, about 30 days before ear emergence.

5. Cannell showed in growth room experiments that high temperatures reduced the production of coleoptile node tillers, but only slightly affected the others.

6. Kirby's irrigation experiments showed that low soil moisture deficits just prior to earing increased the production of tillers and their survival to become ears. Natural rainfall had a similar effect.

The E.B.C. trial data for Kenia and Union barley were examined for responses to these factors.

Nitrogen

The range of pre sowing application varied from 14-70 kg/ha, but there was no obvious relation with ear number. Sometimes split applications were used in very wet weather, but this did not appear to affect ear numbers. The soil of the trial fields may have had a good nitrogen status and fertilizer may have been applied at a rate sufficient to "top up" estimated losses by previous crops.

Temperature

Cool weather did not appear to encourage high ear numbers even though some notably cool springs occurred.

Radiation

An increase in the amount of light at a tiller can be obtained by reducing plant density or by increasing the supply of incident radiation. The correlation between ears per plant and plant density (plants per square metre) was -0.77 for Kenia barley (19 trials), and - 0.86 for Union barley (17 trials). One Spanish trial run at a very low density (88 plants per sq. m.) was omitted since a linear fit to the data was not suitable. A better fit was obtained by using logarithm of plant density. This would agree with Kirby's results which indicated a good fit to a log scale for plant densities in the range 50-1,600 plants per sq. m. The linear relation is satisfactory for the E.B.C. data due to the smaller spread of density (150-400 plants per sq. m.).

The secondary radiation factor is expected to be the incoming solar supply over the period of tillering. Estimates of potential transpiration for successive 10 day periods were made from April to June for all the trials. Partial correlations between ears per plant and potential transpiration were obtained for each 10 day period with results as follows.

	1-10 April	11-20 April	21-30 April	1-10 May	11-20 May	21-31 May	1-10 June	11-20 June	21-30 June	1-10 July
Kenia (19 trials)	0.50*	0.58*	0.45*	0.54*	0.65**	0.45*	0.01	0.11	-0.16	-0.24
Union (17 trials)	0.20	0.19	0.09	0.23	0.25	0.44*	-0.32	0.14	0.17	0.22

* Significant at P=0.1
** Significant at P=0.01

The highest correlation occurrs during mid or late May which would agree with Aspinall's critical stage about 30 days before ear emergence. The relation for Union is less significant than for Kenia, but in both cases there is a marked change in the correlation during early June. The correlation for Kenia becomes small and for Union it fluctuates, but is not significant.

Soil Moisture

Kirby's experiment which showed an increase in ear number in response to irrigation was performed at Cambridge in 1966. The following table gives estimates of soil moisture deficit under barley at Cambridge in 1966.

Date	Soil Moisture Deficit (mm) (± 10%)	Date	Soil Moisture Deficit (mm) (± 10%)
24 April	0	11 June	79
30 April	8	18 June	84
7 May	16	25 June	65
14 May	26	2 July	78
21 May	34	9 July	87
28 May	45	16 July	92
4 June	63		

Soil moisture deficit increased steadily from brairding to the fourth week in June when rain caused some temporary recharging of the soil profile. Irrigation began on 7 June when the deficit would be between 65 and 70 mm. This and subsequent irrigations maintained the deficit between 25 and 50 mm. Tillering and ears per plant were substantially increased by this treatment. The natural recharging which occurred in late June increased tillering in unirrigated crops.

This experiment shows that recharging of the soil profile from deficits in excess of 65 mm for even a week is sufficient to increase tillering.

Soil moisture deficits were calculated for the E.B.C. trials from the end of March until mid July. The following 7 trials had soil water recharge when the deficit exceeded 65 mm.

Deficits in mm (± 10 %). * Recharge period

Trial	Holland 1963	England 1963	Holland 1956	France 1956	Holland 1961	France 1966	Belguim 1968
Date							
April 30	25	12	31	12	9	5	12
May 10	28	20	64	41	26	0	1
May 20	32	28	83	68	52	18	20
May 31	49	52	95	77*	80	50	40
June 10	84*	84	101*	56*	91	84	62
June 20	62*	93*	98*	54*	92	90	69
June 30	45*	89*	105	79	110	97*	79*
July 10	47	82*	112*	90	123*	94*	68*
July 20	64	91	96*	92	85*	41*	70
Ears per plant	3.09	1.45	3.33	2.28	2.95	1.75	2.44

The trial in France (1956) came nearest to the conditions of Kirby's experiment, but 2.28 ears per plant is not a high number. Other trials give mixed results. Some trials (not in the table) had soil near field capacity for much of the growing season, but high ear numbers did not follow. Similarly, dry seasons gave mixed results for ear number.

Conclusions

1. Plant spacing is the major factor determining ear number.

2. Solar radiation in mid and late May has a small effect on ear number.

3. Ear number may not be directly affected by water, but by an indirect effect e.g. increased nitrogen uptake. Also it is possible that the EBC data may be at fault. The count of ear number was made "after ear emergence", and this procedure may have missed late ears produced from tillers which survived due to favourable rainfall at ear emergence.

Any comments or criticisms should be sent direct to the author.

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